

AD-A262 345



NOT MEASUREMENT  
SENSITIVE

MIL-STD-91621 (MC)

November 2, 1992

20000920014

DTIC  
ELECTE  
MAR 18 1993  
S C D

# MILITARY STANDARD

PRINCIPLES OF INSPECT, REPAIR ONLY AS  
NECESSARY (IROAN) PROCEDURES AND  
PREPARATION OF IROAN PUBLICATIONS

Reproduced From  
Best Available Copy



AMSC N/A

AREA SDMP

DISTRIBUTION STATEMENT A. Approved for public release; distribution is unlimited.

93 3 17 027

93-05561



X688

FOREWORD

The United States Marine Corps is committed to reduction of equipment maintenance costs, while maintaining combat essential equipment in a high state of readiness. This can be accomplished by designing products of dependable and maintenance-free materials and utilizing more effective maintenance procedures and extended maintenance intervals where applicable. Manufacturing maintenance free materials and equipment is cost prohibitive; therefore, the use of more effective maintenance procedures is the preferred method. Application of proper maintenance procedures enables military equipment of modern design and materials to be maintained in a serviceable condition throughout their expected life cycle. Simply stated, the Inspect and Repair Only As Necessary (IROAN) concept is a method of performing the minimum depot level scheduled maintenance necessary to keep equipment items in a "serviceable condition".

MIL-STD-91621 (MC)

CONTENTS

<u>PARAGRAPH</u>		<u>PAGE</u>
1.	SCOPE . . . . .	1
1.1	Scope . . . . .	1
1.2	Applicability . . . . .	1
1.3	Tailoring . . . . .	1
2.	APPLICABLE DOCUMENTS . . . . .	1
2.1	Government Documents . . . . .	1
2.1.1	Specifications and standards . . . . .	1
2.1.2	Other Government documents, drawings, and publications . . . . .	3
2.2	Order of Precedence . . . . .	3
3.	DEFINITIONS . . . . .	4
3.1	Characteristic . . . . .	4
3.2	Condition Code A . . . . .	4
3.3	Critical defect . . . . .	4
3.4	Defect . . . . .	4
3.5	Energize . . . . .	4
3.6	IROAN . . . . .	4
3.7	Major defect . . . . .	4
3.8	Minor defect . . . . .	4
3.9	Rebuild . . . . .	4
3.10	Reliability Centered Maintenance (RCM) . . . . .	4
3.11	Unclassified defects . . . . .	5
4.	GENERAL REQUIREMENTS . . . . .	5
4.1	Item selection for IROAN program . . . . .	5
4.1.1	Midpoint of item operational life . . . . .	6
4.1.2	Prior to midpoint . . . . .	6
4.1.3	After midpoint . . . . .	6
4.2	Rebuild Standards . . . . .	6
4.2.1	General . . . . .	6
4.2.3	Instructions for use of the illustrated parts breakdown . . . . .	7
4.2.4	Inspection of parts . . . . .	7
4.2.6	Final inspection and acceptance testing . . . . .	7
4.2.7	General inspection requirement . . . . .	7
4.3	Quality Assurance . . . . .	8
4.3.1	Responsibility . . . . .	8
4.3.1.1	Nondestructive inspection . . . . .	8
4.3.1.2	Welding inspections . . . . .	8
4.3.2	Inspection forms, reports, and records . . . . .	8
4.3.3	Inspection requirements . . . . .	8
4.3.3.1	Preinduction check . . . . .	8
4.3.3.2	Prerepair inspection . . . . .	9
4.3.3.3	Component inspection . . . . .	9
4.3.3.4	In process assembly inspections . . . . .	9

MIL-STD-91621 (MC)

4.3.3.5	Final inspection . . . . .	9
5.	DETAILED REQUIREMENTS FOR PREPARATION OF IROAN PUBLICATIONS . . . . .	9
5.1	General . . . . .	9
5.2	Basic IROAN document . . . . .	10
5.2.1	Cover page . . . . .	10
5.2.2	Record of changes . . . . .	10
5.2.3	Table of contents . . . . .	10
5.2.4	Safety summary . . . . .	10
5.2.5	Statement of the Scope, Purpose and Requirement . . . . .	10
5.2.5.1	Scope . . . . .	10
5.2.5.2	Purpose . . . . .	10
5.2.5.3	IROAN requirements . . . . .	10
5.2.6	IROAN flow chart . . . . .	10
5.3	IROAN Instruction . . . . .	10
5.3.1	Heading . . . . .	10
5.3.2	Table of contents for the Section . . . . .	10
5.3.3	IROAN description . . . . .	10
5.3.3.1	Scope . . . . .	10
5.3.3.2	Applicable Standards . . . . .	10
5.3.3.3	IROAN Phases . . . . .	11
5.3.3.4	Special equipment . . . . .	11
5.3.3.5	Test procedures . . . . .	11
5.3.3.6	Pass/Fail . . . . .	11
5.3.3.7	Mandatory replacement parts . . . . .	11
5.3.3.8	Finishing . . . . .	11
5.4	Safety . . . . .	11
5.4.1	Safety during testing . . . . .	11
5.4.2	Safety marking . . . . .	11
5.5	Inspection . . . . .	11
5.6	Mandatory parts replacement under the IROAN concept of maintenance . . . . .	12
5.7	Disassembly . . . . .	12
5.8	Serviceability . . . . .	12
5.9	Repair/replacement . . . . .	12
5.10	Defects . . . . .	12
5.11	Corrosion . . . . .	13
5.12	Operational . . . . .	13
5.13	Inspection of parts . . . . .	13
5.14	Configuration . . . . .	13
5.15	Final acceptance record . . . . .	13
6.	NOTES . . . . .	14
6.1	General . . . . .	14
6.2	Intended use . . . . .	14
6.3	Tailoring guidance . . . . .	14
6.4	Technical manual acquisition . . . . .	14
6.5	Subject term (key word) listing . . . . .	14

MIL-STD-91621 (MC)

**FIGURES**

- 1 Sample Checklist (Sheet 1 of 4)
- 1 Sample Checklist (Sheet 2 of 4)
- 1 Sample Checklist (Sheet 3 of 4)
- 1 Sample Checklist (Sheet 4 of 4)
- 2 Sample Repair Concept (Sheet 1 of 2)
- 2 Sample Repair Concept (Sheet 2 of 2)
- 3 Sample Repair Procedures (Sheet 1 of 3)
- 3 Sample Repair Procedures (Sheet 2 of 3)
- 3 Sample Repair Procedures (Sheet 3 of 3)
- 4 Sample Title Page
- 5 Sample Record of Changes
- 6 Sample Table of Contents
- 7 Sample Safety Summary
- 8 Sample Example of Basic Introduction Chapter
- 9 Sample Flow Plan
- 10 Sample Major Assembly Chapter (Sheet 1 of 2)
- 10 Sample Major Assembly Chapter (Sheet 2 of 2)
- 11 Sample of Special Equipment List
- 12 Sample Engine Run-In Data Sheet (Sheet 1 of 2)
- 12 Sample Engine Run-In Data Sheet (Sheet 2 of 2)
- 13 Sample Test Procedures
- 14 Example of Detail Finishing Procedures

DTIC QUALITY INSPECTED 1

Accession For	
NTIS CRA&I	<input checked="" type="checkbox"/>
DTIC TAB	<input type="checkbox"/>
Unannounced	<input type="checkbox"/>
Justification	
By	
Distribution /	
Availability Codes	
Dist	Avail and/or Special
A-1	

## 1. SCOPE

1.1 Scope. This military standard addresses the Inspect, Repair Only As Necessary (IROAN) procedure, presents guidelines for establishing an IROAN program, and sets the criteria for developing the IROAN standards publication. IROAN is defined as "That maintenance technique which determines the minimum repairs necessary to restore equipment, components, or assemblies to prescribed serviceability standards by utilizing all diagnostic equipment and test procedures in order to minimize unnecessary disassembly and parts replacement". Serviceability standards shall be met to ensure excellent operating capability. This is done, in part, by utilizing all available diagnostic equipment and test procedures to eliminate unnecessary disassembly and parts replacement. IROAN standards are constructed to provide guidance for scheduling depot level repair and are utilized in conjunction with depot repair standards and/or depot maintenance work requirements (DMWR).

1.2 Applicability. This standard is applicable to the U.S. Marine Corps and its contractors and is available for use by all Departments and Agencies of the Department of Defense. Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, MARCORSYSCOM, Program Support Directorate (Code PSE-P), 2033 Barnett Avenue, Suite 315, Quantico, Virginia 22134-5010. Utilize the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or submit comments by letter.

1.3 Tailoring. When developed by the prime hardware contractor, the IROAN standards shall be developed concurrently with the depot repair standards and become an integral part of the equipment maintenance publications, Maintenance Instruction, Repair Parts List (Organizational, Intermediate and Depot (-25&P)) or a separate supplement, as appropriate. If IROAN standards were not developed during the initial procurement of the hardware, they shall supplement the existing rebuild standard in order to avoid duplication of effort.

## 2. APPLICABLE DOCUMENTS

### 2.1 Government Documents.

2.1.1 Specifications and standards. The following specifications, standards, and publications form a part of this document to the extent specified. Unless otherwise specified, the issues of these documents shall be those listed in the effective issue of the Department of Defense Index of Specifications and Standards (DODISS) and supplement. Hard copies of DODISS are available from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402-0001 or through the

**MIL-STD-91621 (MC)**

Director, Naval Publications and Printing Service Office, 7000  
Robbins Avenue, Philadelphia, PA 19111-5093 for microfiche.

**MILITARY SPECIFICATIONS**

MIL-M-38784	Manuals, Technical: General Style and Format Requirements
MIL-P-38790	Printing Production of Technical Manuals, General Requirements for
MIL-I-45607	Inspection Equipment, Acquisition, Maintenance, and Disposition of
MIL-A-85045	Cable Fiber Optic (Metric), General Specification for

**MILITARY STANDARDS**

MIL-STD-12	Abbreviations for Use on Drawings, and in Specifications, Standards, and in Technical Documents
MIL-STD-410	Nondestructive Testing Personnel, Qualification and Certification (Eddy current, liquid penetrant, magnetic particle, radiographic, and ultrasonic)
MIL-STD-453	Inspection, Radiographic
MIL-STD-454	Standard General Requirements for Electronic Equipment
MIL-STD-721	Definitions of Terms for Reliability and Maintainability
MIL-STD-1265	Radiographic Inspection, Classification and Soundness Requirements for Steel Castings
MIL-STD-1309	Definition of Terms for Test, Measurement, and Diagnostic Equipment.
MIL-STD-1949	Inspection, Magnetic Particle
MIL-STD-6866	Inspection, Liquid Penetrant
MIL-STD-45662	Calibration System Requirements

**MILITARY PUBLICATIONS**

TM-9-214	Inspection and Care/Maintenance of Anti-Friction Bearings
TM-9-4910-571-34&P	STE/ICE (Standard Test Equipment/Internal Combustion Engine)

**MIL-STD-91621 (MC)**

TM-750-245-4	Defect Classification Guide
TM-3080-50	Corrosion Control Procedures, Depot Maintenance Activities for Marine Corps Equipment
TM-4750-15/1	Painting and Registration for Marine Corps Combat and Tactical Equipment
TM-4750-15/2	Camouflage Paint Patterns
TI-4733-15/1A	Calibration Procedures
Naval Ship 0900-003-8000	Inspection of Welds
Naval Ship 0900-003-9000	Inspection of Welds
MCO P3900.13	Systems Engineering Manual
MCO P4400.82	Marine Corps Unified Material Management System
MCO 4855.2	Marine Corps Quality Program
MCO P5215.17	Marine Corps Technical Publications

**NONGOVERNMENT PUBLICATIONS**

ANSI B46.1 1962	American National Standards Institute
-----------------	---------------------------------------

**2.1.2 Other Government documents, drawings, and publications.** The following other government documents, drawings, and publications form a part of this specification to the extent specified herein. Unless otherwise specified, the issues shall be those in effect on the date of the solicitation.

U.S. Government Printing Office Style Manual, Library of Congress Catalog No. Z253.U58

The GPO Style Manual is available from the Superintendent of Documents, U.S. Government Printing Office, Washington DC 20402-0001.

Unless otherwise indicated, copies of federal and military specifications, standards, and handbooks are available from the Naval Publications and Forms Center (ATTN: NPODS), 5801 Tabor Avenue, Philadelphia, PA 19120-5900.

Marine Corps Orders (MCO) are available through Commandant of the Marine Corps (Code ARE-B), Washington, DC 20380-0001.

**2.2 Order of Precedence.** In the event of a conflict between the text of this document and the references cited, the text of this document takes precedence. Nothing in this document supersedes



**MIL-STD-91621 (MC)**

applicable laws and regulations unless a specific exemption has been obtained.

**3. DEFINITIONS**

**3.1 Characteristic.** Any dimensional, visual, functional, mechanical, electrical, physical, or material feature or property; or any control element which describes or establishes the design, fabrication, and operational requirements of an article or material.

**3.2 Condition Code A.** New, used, repaired or reconditioned material which is serviceable and issuable to all customers without limitation or restriction.

**3.3 Critical defect.** A critical defect is a defect that judgement and experience indicate is likely to result in hazardous or unsafe conditions for the individual using, maintaining, or depending upon the product; or a defect that is likely to prevent the operational availability of an end item.

**3.4 Defect.** A defect is any identifiable nonconformance of a specified characteristic.

**3.5 Energize.** To activate a system utilizing the means necessary to place the item in a condition for testing.

**3.6 IROAN.** That maintenance technique which determines the minimum repairs necessary to restore equipment, components, or assemblies to prescribed serviceability standards by utilizing all diagnostic equipment and test procedures in order to minimize disassembly and parts replacement. Items will be restored to Condition Code A.

**3.7 Major defect.** A major defect is a defect, other than critical, that is likely to result in failure or materially reduce the usability of the product for its intended purpose.

**3.8 Minor defect.** A minor defect is not likely to materially reduce the usability of the product for its intended purpose, or is a departure from established standards having little bearing on the effective use of the unit.

**3.9 Rebuild.** The restoration of an item to a standard as near as possible to its original condition in appearance, performance and life expectancy.

**3.10 Reliability Centered Maintenance (RCM).** A maintenance concept that employs an analytical methodology to identify the components of a hardware system and influences the decision-making in determining the minimum amount and type of maintenance that must be accomplished in order to maintain or restore design levels of reliability.

3.11 Unclassified defects. Any defect having no effect on function, safety, interchangeability or life, but is a departure from good workmanship will be noted in writing.

#### 4. GENERAL REQUIREMENTS

4.1 Item selection for IROAN program. Traditionally, vehicles/components were nominated for the rebuild (R&E) program based primarily on an interval of time since acquisition or last rebuild cycle. Because items were often nominated for the R&E program with minimal consideration given to miles, hours, rounds fired or the overall condition and serviceability of the item, unnecessary complete tear down and rebuild of end items and components occurred. Items were not tested prior to induction into the rebuild cycle at the DMA. An item was inducted and disassembled regardless of the condition of the item. Thus items were often processed through depot maintenance when this level of repair was not required. The RCM concept has proven that complete teardown and repair of an end item based on calendar time is not cost effective. With modern day materials, manufacturing techniques and lubricants, the IROAN technique of maintenance is the choice for depot level maintenance to ensure a serviceable product in the most cost effective, timely, and efficient manner. In the past, many parts and subassemblies had a limited usable life span before replacement was required. With today's materials and technology, some subassemblies of major end items are designed to last the entire life cycle of the end item without teardown or replacement if normal scheduled maintenance procedures are followed. Thus, previous criteria for determining when an item should be nominated for depot level maintenance do not apply. Diagnostic equipment, test procedures and oil analysis combined with preinduction inspections are some of the tools used in the IROAN concept of maintenance. Use of these tools by qualified personnel will assist in determining what items require repair, and what diagnostic disassembly must be performed to effect repair, replacement or modification to restore an end item or component to a serviceable condition in the most expeditious and cost efficient manner. This also precludes unnecessary disassembly and repair. When the IROAN concept of maintenance is used, the criteria for selection of candidates for repair is a significant change from the old rebuild requirements.

As a matter of policy, all Marine Corps GROUND EQUIPMENT items whose unit acquisition/replacement cost does not exceed 65 percent of the current unit price or current acquisition cost may become a candidate for IROAN. An item selected for the IROAN program need not be classified as unserviceable, but must be economically repairable; that is the cost of repairs to restore the item to Condition Code A does not exceed the maximum limits imposed by current Marine Corps directives. It is the specific intent of this standard to permit maximum flexibility to operational commanders in the selection of candidates for IROAN so as to maintain maximum equipment availability at minimum support costs. An item may become a candidate for IROAN at any

MIL-STD-91621 (MC)

time during its life cycle if it meets one of the following criteria.

4.1.1 Midpoint of item operational life. The midpoint of item operational life is determined by the approved operational requirements document that justified the procurement. This can be Operational Hours, Rounds Fired, Miles Driven, etc. An item may have an expected life cycle of 50,000 operating hours over 10 years, but due to missions/usage it may reach 25,000 hours in 4 years. The 25,000 hours is the driver for induction into the IROAN program, not the calendar time.

4.1.2 Prior to midpoint. If an item cannot perform its mission due to material deficiency or unexpected harsh operating environment, it may be inducted into the IROAN program before it reaches its midpoint.

4.1.3 After midpoint. IROAN may be deferred at an item's midpoint if it is determined by the organizational commander that the item can perform its mission in accordance with the approved operational requirements document.

4.2 Rebuild Standards. Rebuild standards are developed to provide a method of repairing an end item/component. The IROAN standard provides a maintenance inspection technique to determine minimum repairs required to restore end items/components to Condition Code A. IROAN Standards will utilize the available checklist, parts breakdown etc. from rebuild standards if they exist. Once this is determined, the rebuild standard must be available for the technician to follow to accomplish the repair.

4.2.1 General. This only covers a portion of the information and direction contained in rebuild standards. Rebuild standards must be accurate and effective to ensure that the IROAN concept of maintenance is a viable, cost effective means to ensure serviceability of equipment.

4.2.2 Use of Rebuild Standards. Pertinent sections of a rebuild standard may be broken out in any order to be used by various branches of a rebuild facility or different rebuild facilities. Throughout a rebuild standard, item numbers (keyed to the Illustrated Parts Breakdown) are used to identify parts of the component. Part numbers (PNs) and/or National Stock Numbers (NSNs) are keyed to the item number for identification purposes. Whenever an item is listed with the notation "No PN" that part cannot be requisitioned/procured as a separate item and the next higher assembly must be used. If an item is listed as "No NSN" a National Stock Number has not been assigned and the item must be requisitioned/procured by the part number. Commercial and Government entities (CAGE) numbers are provided with the PNs and NSNs except for military standard items under the authority of the Defense Standardization Manual, aeronautical standard items under the authority of Navy, Air Force, or National Aerospace Standards. Military specification (MIL-SPEC) parts are not required unless specified in the rebuild standard. Dimensions

given in rebuild standard are in inches unless otherwise specified.

**4.2.3 Instructions for use of the illustrated parts breakdown.** The item numbers in the Illustrated Parts Breakdown are ordered in the disassembly sequence to aid in disassembly and reassembly of a component. However, since there are often many different sequences that can be used to disassemble and reassemble a component, the sequence given in a rebuild standard is only intended to be a guide to avoid possible difficulties in disassembly and reassembly. Complete disassembly of many components is not required since many parts can be inspected/ repaired in place. Unless otherwise specified in the rebuild standard, disassembly is authorized to the extent required to repair and ensure all reusable parts can be inspected according to the rebuild standard.

**4.2.4 Inspection of parts.** The inspection tables in the applicable rebuild standards specify the inspection requirements and permissible repairs for normal wear and damage only. Inspection and repair of gross damage (resulting from accident or mishandling) or extensive wear must be performed with direct engineering guidance. Unless otherwise specified, inspection for cracks and corrosion require visual inspection only. Minor damage is defined as damage that does not affect the form, fit, or function of a part. Localized defects or repairs are defined as defects or repairs that cover less than 10% of any one surface. Surface roughness values specified in the inspection tables are to be in accordance with ANSI B46.1-1962. Unless otherwise specified, use of a proflowmeter is not required. Visual and tactile comparison with reference specimens is sufficient.

**4.2.5 Paint Stripping.** Complete paint stripping of parts is not mandatory. Unless otherwise specified in the rebuild standard, stripping is only required when the paint finish is defective and must be replaced or the paint finish must be removed to properly inspect the parts.

**4.2.6 Final inspection and acceptance testing.** The order of inspections and tests is arbitrary and may be varied to suit the needs of the rebuild facility. Torque checks and other assembly checks may be performed as in process inspections.

**4.2.7 General inspection requirement.** This paragraph provides the general inspection requirements applicable to all parts. Since the inspection tables in the rebuild standards cover only inspection of those features of a part which are normally subject to wear and damage, the other features of a part must be inspected as follows. Visually inspect the part to determine whether it has the same form, fit, and function of a usable part. Direct comparison with a new part or with the detail drawing may be required. No visible cracks or corrosion, no deterioration of metallic or conversion coatings, or damage which would affect the part's serviceability is allowed. When a part's usability is in

MIL-STD-91621 (MC)

doubt either the part should be discarded or its usability determined with direct engineering guidance.

**4.3 Quality Assurance.** A quality assurance (QA) program will be established at each rebuild facility, both organic and non-organic, to ensure that items are restored to Condition Code A. It is not the intent of this standard to write specific QA procedures; however, the following requirements are identified as a guide.

**4.3.1 Responsibility.** The head of the quality assurance organization is responsible for administering and maintaining the quality assurance program to fulfill the requirements of applicable Marine Corps directives. Inspections will be conducted as a function of the repair process to ensure the end item/components are free from defective materials or poor workmanship as specified in the contract, Military Intradepartmental Purchase Request (MIPR), or repair standard. The quality assurance organization is responsible for verification of the in process inspections and final acceptance in accordance with the item's approved inspection plan.

**4.3.1.1 Nondestructive inspection.** Personnel performing magnetic or penetrant inspection will be qualified in accordance with MIL-STD-410, Nondestructive Testing Personnel Qualification and Certification. Inspections will be in accordance with MIL-STD-6866, Inspection, Liquid Penetrant or MIL-STD-1949, Inspection, Magnetic Particle.

**4.3.1.2 Welding inspections.** Procurements for radiographic frequency inspections of castings or weldments shall be in accordance with MIL-STD-1265, Radiographic Inspection, Classification and Soundness Requirements for Steel Castings. Operators and equipment will be certified in accordance with MIL-STD-453, Inspection, Radiographic to conduct X-ray inspection of welds. Weld procedures will be in accordance with NAVSHIP 0900-003-8000 and 0900-003-9000, Inspection of Welds.

**4.3.2 Inspection forms, reports, and records.** All inspection documents will be completed to ensure adequate quality control and that an audit trail is established. Completed checklists as well as any local records designated by quality control personnel will be retained by the quality control organization. These records will be compiled as part of a historical data base.

**4.3.3 Inspection requirements.** The following inspections and/or analysis functions are necessary to verify that the technical and functional test portions of the IROAN process are in accordance with the specifications requirements sample checklist, Figure 1. Inspections, tagging, reporting, resolution of conflicts and pre-operational checks shall be conducted in accordance with current DMA operating procedures. The PMCS table can be used as a starting point.

**4.3.3.1 Preinduction check.** Preinduction check/analysis shall be conducted on each item before induction into the IROAN

program. Figure 1, Sheet 1 is a typical example of the preinduction required for motor transport equipment.

4.3.3.2 Prerepair inspection. During disassembly of an end item/component, an inspection will be made of the disassembled parts and a determination made whether they are serviceable, repairable, or unrepairable.

4.3.3.3 Component inspection. Inspection stations shall be maintained in all shops within the maintenance activity to ensure that components, subassemblies and material fabricated, repaired, or processed within the various shops conform to the IROAN standard and other appropriate requirements. Conformance will be indicated by an appropriate tag. Components shall not be used in end item assembly unless accepted by the appropriate shop inspector.

4.3.3.4 In process assembly inspections. In process inspections shall be conducted during the assembly phase to detect and prevent defects which might otherwise go undetected or require more costly corrective action if detected at later inspections. It is the responsibility of the inspector to assist the shop supervisors in preventing defects and reducing job cost. Inspectors will cooperate with shop supervisors in scheduling in process inspections to minimize delays or conflict with work progress. All shop processes shall be monitored on a random type inspection basis to ensure conformance of workmanship and prescribed shop practice.

4.3.3.5 Final inspection. Final end item/component inspection will be recorded on inspection check sheets. Comparison of the final check sheets will be against the original preinduction check sheets to ensure all defects are corrected. Final inspection shall consist of an operational test that exercises all operational modes of the item and shall be sufficient length to ensure the item is operational and serviceable to perform its mission. Corrective action taken shall be indicated by the technician and certified by a QA inspector.

## 5. DETAILED REQUIREMENTS FOR PREPARATION OF IROAN PUBLICATIONS

5.1 General. An IROAN standard contains the procedures/tests required to determine if a component requires repair. The details of the actual repair task are contained in depot level repair manuals. An effective IROAN program requires proper application of the data contained in all TM 50s, TM 25&P, DMWRs and Rebuild Standards. Whenever practical, the IROAN standard should be designed to provide definitive tests for major assemblies to determine if disassembly and repair is required. For example, a comprehensive engine dynamometer test procedure and record sheet would provide a good indication of engine condition and in consonance with other criteria, would determine if the engine would require any disassembly or repair. If repair is required, the IROAN standard would reference the appropriate

MIL-STD-91621 (MC)

section of a TM 25&P, rebuild standard, or DMWR. Additionally, an overview of the depot repair process envisioned should be provided (See Figures 2 and 3).

5.2 Basic IROAN document. The basic document shall consist of:

5.2.1 Cover page. (See Figure 4).

5.2.2 Record of changes. (See Figure 5).

5.2.3 Table of contents. (See Figure 6).

5.2.4 Safety summary. (See Figure 7). This summary shall list each of the safety notices mentioned in the text. The page on which the notice appears shall be displayed or shown in the Figure.

5.2.5 Statement of the Scope, Purpose and Requirement. (See Figure 8). This is the introduction chapter and covers the information in a general manner.

5.2.5.1 Scope. Sets forth the overall mission of the manual.

5.2.5.2 Purpose. Establishes generally what will be done.

5.2.5.3 IROAN requirements. Provides the overall guidance for performance and accomplishment.

5.2.6 IROAN flow chart. (See Figure 9). This establishes the path of the equipment through the preinduction inspection (Figure 1), required maintenance actions, and final preparations; it also establishes the major pass/fail points and instructions for appropriate actions.

5.3 IROAN Instruction. These instructions are established for each major assembly and written as individual chapters. The chapters should be, along with the checklists, stand-alone entities for that assembly and enable the specific shop to retain only the pertinent portion rather than the entire document. A chapter for a major assembly (Figure 10) is broken down into sections covering the assembly in general and the specifics of the subassemblies. The sections shall contain:

5.3.1 Heading (Section Title)

5.3.2 Table of contents for the Section

5.3.3 IROAN description

5.3.3.1 Scope. Specifies exactly the item to be processed and any ancillary equipment related to this item to be processed.

5.3.3.2 Applicable Standards. Lists the appropriate standards within the chapter that relate to the subassemblies or the ancillary equipment.

5.3.3.3 IROAN Phases. Divides the procedure into distinct phases and actions.

5.3.3.4 Special equipment. (See Figure 11). Lists the special equipment necessary to remove, reinstall or test the subassembly.

5.3.3.5 Test procedures. (See Figure 12 and 13). This section lists the required preinduction tests and inspections. These instructions should be detailed and cover the complete subassembly and ancillary equipment.

5.3.3.6 Pass/Fail. This section covers the criteria used to determine the suitability of a part and the disposition of failed items. The level of disassembly will be established and the appropriate rebuild procedure will be referenced.

5.3.3.7 Mandatory replacement parts. (See Figure 10 (Sheet 2 of 2)). The mandatory replacement parts and the degree of allowable repair are established in this section.

5.3.3.8 Finishing. (See Figure 14). Detail the degree and limits for the finished item in this section.

5.4 Safety. Due to the nature of very complex combat systems, it is difficult and sometimes impractical to design the system completely hazard free. Since the majority of items in the IROAN program are combat or combat support equipment, safe practices must be followed and safety precautions rigidly adhered to during the maintenance procedure. It is the responsibility of the author of the standards that these safety guidelines are established and appear prominently in the text of the standard.

5.4.1 Safety during testing. During preinduction testing, extreme caution shall be observed to avoid the possibility of the failure of a safety related part or system, such as brakes or dangerous levels of carbon monoxide. Safety related items must be operational prior to the resumption of testing.

5.4.2 Safety marking. Certain maintenance procedures require that precautionary steps be taken to insure safe operations and minimize the possibility of accidents. These situations must be covered in the IROAN standards. An example of IROAN safety summary is provided in Figure 7; and examples of the use of cautions and warnings is provided in Figure 10.

5.5 Inspection. A visual inspection will be made of the end item/component to determine if subassemblies are missing or not properly attached and whether there are any obvious defects that would preclude energizing the end item/component. If the end item/component cannot be energized, the inspection sheets located in the appropriate IROAN standard will be used to determine the scope of the problems and estimate the parts and labor required to correct them. If the end item/component can be energized, fluid samples will be taken from the engine, transmission and hydraulic system. These samples will be analyzed with a spectrometer and tested for physical properties. Fluids should



MIL-STD-91621 (MC)

be added as required to ensure proper levels. The IROAN standard shall include inspection sheets that will be used to ensure that the entire item or component is inspected. Notations/remarks will be entered on the inspection check sheets to indicate condition and problem areas, and those items requiring adjustment or replacement. Results of road testing, STE/ICE testing, etc., will also be recorded. Criteria for these tests will be provided in the IROAN standard or the source documents will be referenced. The inspections enumerated will be evaluated and will assist in determining the level of disassembly required to repair or replace subassemblies in concert with IROAN techniques.

In process and final inspections and requirements are located in paragraphs 4.3.3.4 and 4.3.3.5.

5.6 Mandatory parts replacement under the IROAN concept of maintenance. Components or assemblies will not be disassembled for replacement of mandatory parts unless that part has failed or the component wherein the part is located is disassembled for repair.

5.7 Disassembly. The end item will be disassembled to the extent required to inspect parts and components and effect the repair/replacement of unserviceable items. The IROAN procedure may require certain items to be disassembled for internal inspection when no other test or inspection technique will suffice. For example, partial disassembly may be required to ensure proper cleaning, detection and removal of corrosion, and allow inspection of structural components which cannot be visually inspected without partial disassembly. Disassembly may be required for incorporation of "URGENT" modification instructions/engineering change proposals. Modification instructions (MIs) and engineering change proposals (ECPs) not classified "URGENT" will be installed if parts/kits are available and the end item/component is disassembled for repair/replacement.

5.8 Serviceability. All parts and components removed will be inspected to determine if they may be reused. Assemblies, components and parts may be reused if they meet the serviceability standards as set forth in the applicable IROAN or Rebuild standard.

5.9 Repair/replacement. Components and parts which are determined to be unserviceable will be repaired or replaced as required to ensure that the end item is Condition Code A.

5.10 Defects. A defect is any identifiable nonconformance of a specified characteristic. A characteristic is any dimensional, visual or functional, mechanical, electrical, physical, or material feature or property; or any control element which describes and establishes the design, fabrication, and operational requirements of an item or material. Any defect that would impact safety or serviceability is not allowed.

**5.11 Corrosion.** Corrosion is the deterioration of a metal as a result of an electrochemical reaction with its environment. There are many types/classes of corrosion and the effect of corrosion on various metals. Stage three corrosion is not acceptable on thin metal surfaces, or stage four on any surfaces; however, stage three corrosion on thicker surfaces (hardware, brackets and components) is not justification for rebuild or replacement. Corrosion removal and corrective treatment procedures in TM-3080-50 will be followed when an item of equipment is processed through an IROAN program. Preparation and painting of end items/components of U.S. Marine Corps equipment shall be in accordance with TM-4750-15/1 and TM-4750-15/2-1.

**5.12 Operational.** End items/components will be inspected and tested in accordance with procedures contained in IROAN and rebuild standards. Parts and components that do not meet the required standards will be repaired or replaced. No defects that impact serviceability of the end item/component is allowed. Upon completion of the IROAN of an end item/component, it will be subjected to final testing under the cognizance of the quality control organization to ensure that it meets or exceeds the requirements set forth in various TMs and directives to ensure it is operational and in serviceable Condition Code A.

**5.13 Inspection of parts.** Inspect parts, components, and assemblies to determine if they may be reused. These items may be reused if they meet or exceed the specifications and requirements set forth in applicable IROAN and rebuild standards. Repair or replace all items that are unserviceable. Many small inexpensive items are classified as mandatory replacement items in the rebuild standards. These items will be replaced if they have failed or if the component, or assembly where they are located is disassembled for any reason.

**5.14 Configuration.** The configuration of end items, components, and assemblies will be the same as when inducted for IROAN maintenance. The only exceptions will be the application of approved ECPs and MIs in accordance with the current statement of work.

**5.15 Final acceptance record.** The record of acceptance shall consist of all acceptance documentation; i.e., quality inspection reports, inspection sheets, oil analysis results, performance results from dynamometer testing of the engine and transmissions; other specialized testing, modification listing and certification record. This record is a certification sheet that the item/component has been repaired in accordance with IROAN requirements. It will be signed by the inspector who performs the final inspection or an authorized quality control organization representative.

A copy of this certification will be placed in the equipment/end item log book/record folder.

MIL-STD-91621 (MC)

6. NOTES

6.1 General. This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.

6.2 Intended use. This document is intended to outline the concept of IROAN. It recommends procedures for the selection of fielded equipment for induction into the depot scheduled maintenance program. It provides a background and a rationale for this selection to allow the commodity manager the versatility to establish the selection criteria for his equipment. Certain mandatory, normally safety related, maintenance actions are described in generic terms. This document establishes the standard for IROAN (plans/programs) instructions to be used at the DMA during the scheduled depot level maintenance.

6.3 Tailoring guidance. This standard shall be used in its entirety by all preparation activities in the development of IROAN Standard publications.

6.4 Technical manual acquisition. This standard must be listed on the Contract Data Requirements List (DD Form 1423) in order to acquire the technical manuals described by this standard, except where DoD FAR Supplement 27.475-1 exempts the requirement for a DD Form 1423.

6.5 Subject term (key word) listing.

- Depot Level Maintenance
- Rebuild
- Serviceable Condition
- Level of Repair
- Reliability, Inherent
- Serviceability
- Diagnostic Disassembly
- Modification
- Economically Repairable

MIL-STD-91621 (MC)

<b>IROAN PREINDUCTION CHECK SHEETS FOR MOTOR TRANSPORT EQUIPMENT</b>		
<b>DATE:</b>  <b>MODEL:</b>		<b>REFERENCES:</b> (Applicable to the Item Being Inspected)
<b>U.S.M.C. NO.MILES:</b>		
<b>JOB ORDER NO.HOURS:</b>		
<b>PRODUCTION NO.</b>		
<b>HULL NO.SERIAL NO.</b>		
<b>ENGINE NO.</b>		
<b>TRANSMISSION NO.</b>		
<b>INSPECTOR'S NAME</b>	<b>BADGE NUMBER</b>	<b>SHOP NUMBER</b>
<p><b>NOTE:</b> The following inspection sheets are divided into ten columns. The inspector will place a check in the column which best describes the condition of the item being inspected, for those items that cannot be inspected for any reason the inspector will make an appropriate annotation in the remarks column. If the inspector finds a defect that could cause injury to the operator or damage to the end item, testing will cease until the defect is corrected or the decision is made to induct the vehicle into the shop.</p>		

FIGURE 1. SAMPLE CHECKLIST (Sheet 1 of 4).

(IROAN) PROCEDURES CHECKLIST									
NOMENCLATURE/LOCATION	S A T	M I S S I N G	S E R V I C E	A D J U S T	R E P A I R	R E P L A C E	M O D I F Y	REMARKS	I N T
OUTSIDE OF VEHICLE									
1. Driver Side/Passenger Side									
1. <u>Body and Cab.</u> Inspect for serviceability. Note broken or missing parts, rust or corrosion.									
a.Operators Side									
b.Passenger Side									
2. <u>Cab Doors.</u> Inspect for damage, misalignment, rust, or corrosion. Ensure all seals and doors are serviceable.									
a.Operators Side									
b.Passenger Side									
3. <u>Vehicle Frame.</u> Visually inspect frame, cross-members and under body for bends, broken welds, and corrosion.									
4. <u>Rubber Insulators.</u> Inspect for tears cracks, bent or broken hardware. <sup>1</sup>									
5. <u>Cab Mounts.</u> Inspect for loose or broken welds and rusted conditions.									

<sup>1</sup>These are mandatory replacement items when disassembled.

FIGURE 1. SAMPLE CHECKLIST (Sheet 2 of 4).

(IROAN) PROCEDURES CHECKLIST									
NOMENCLATURE/LOCATION	S A T	M I S S I N G	S E R V I C E	A D J U S T	R E P A I R	R E P L A C E	M O D I F Y	REMARKS	I N T
OUTSIDE OF VEHICLE									
b. Interior Lights									
c. Search Lights									
d. Work Lights									
e. Tail Lights/Stop Lights/Turn Indicator Lights.									
13. <u>Tires.</u> Inspect all tires for cuts, gouges, cracks and serviceability. Note location in "Remarks" column.									
14. <u>Wheels.</u> Inspect all wheels for broken, cracked, or bent surfaces. Ensure that the side ring and clamp plate are serviceable and fit securely in their grooves. Note location of defective wheels in "Remarks" column.									
15. <u>Wheel Studs and Nuts.</u> Check all wheel studs and nuts for serviceability and inspect for missing nuts. Note defective items in "Remarks" column.									
16. <u>Front Pneumatic Couplings (Glad Hands).</u> Check glad hands for damage. Inspect glad hands for damage. Inspect glad hands for missing or rotted seals.									
a. Operator Side									

FIGURE 1. SAMPLE CHECKLIST (Sheet 3 of 4).

(IROAN) PROCEDURES CHECKLIST									
NOMENCLATURE/LOCATION	S A T	M I S S I N G	S E R V I C E	A D J U S T	R E P A I R	R E P L A C E	M O D I F Y	REMARKS	I N T
OUTSIDE OF VEHICLE									
b. Passenger Side									
II. Undercarriage And Frame									
1. Inspect under the vehicle for fuel, oil, or coolant leakage.									
2. <u>Operator Side.</u> Inspect for missing or broken suspension limit chains.									
<u>Passenger Side.</u> Inspect for missing or broken suspension limit chains.									
3. <u>Transmission.</u> Inspect for cracks, leaks, damage. Check shift cable for kinks and excessive play. Inspect transmission oil pan bolts for looseness and out put shaft seal for damage or leaks.									
a. Cracks/Damage									

FIGURE 1. SAMPLE CHECKLIST (Sheet 4 of 4).

## SECTION III. REPAIR

**2-12. REPAIR.** Repair of the AAV7A1 family of vehicles will be accomplished to return the vehicles to a fully serviceable condition (condition code "A"). All obvious defects will be corrected by the appropriate cost work centers. Dynamometer testing of the engine and transmission will be performed as set forth in the applicable IROAN Standard. Pre-repair inspections will be evaluated to assist in determining the extent of disassembly required. Repair will be accomplished as follows:

- a. Disassemble the vehicle to the extent required to effect repairs as designated by the shop repair order.
- b. Inspect all parts and components.
- c. Repair or replace all parts, components or assemblies that are unserviceable.
- d. All items will be operational.
- e. No defects that would impact serviceability are allowed.
- f. No stage three corrosion on thin metal panels, or stage four on any surfaces.
- g. Stage three corrosion on hardware, brackets and components is not justification for rebuild or replacement. Corrosion will be removed in the most expedient manner consistent with DMA Standards. The cleaned area will be treated with phosphoric solution and allowed to dry. When the area is dry, apply a coat of corrosion preventative compound conforming to MIL-C-85012(AS). Paint the treated areas as directed.
- h. The power plant assembly will be removed from the vehicle to allow thorough cleaning, inspection and repair of any cracks or damage to the hull.
- i. The cooling tower will be removed from the power plant assembly and the radiator will be pressure and flow tested. If the radiator passes these tests, it is considered serviceable and may be reused. If the radiator fails either test, it has failed and TM-07007B-50/16 applies for repair.
- j. The engine and transmission will be separated and tested on a dynamometer. Oil samples will be taken and analyzed at the completion of dynamometer testing. This information, in conjunction with the results of the performance test. STE/ICE and dynamometer testing, will

be used to determine if the engine and/or transmission are serviceable condition code A or require repair. If the engine requires repair refer to TM-88643B-50. If the transmission requires repair refer to TM-84403B-50.

k. Cosmetic blemishes which do not affect performance will not be cause for rejection. They will be handled on a case by case basis in accordance with current DMA Standards.

l. Configuration of vehicles after IROAN will be the same as when the vehicle is received by the DMA with the exception of the application of current ECP's and modifications per current statement of work. ECP's and modifications which are not classified "URGENT" will be installed if:

(1) Parts/kits required are available without work stoppage.

(2) The component or assembly is disassembled for repair/rebuild.

(3) Notation will be made on the Repair/work order of ECP's/modifications installed. Notation will also be made of any applicable ECP or modification not installed and the reason. This information must be transcribed onto the proper page of the vehicle log book to ensure the configuration audit of the vehicle is correct. See TM 4700-15/1.

m. Sprockets, tracks, road wheels, and idlers will be inspected and/or repaired in accordance with applicable IROAN Standards.

n. Final drives will be inspected for leaks and serviceability in accordance with applicable IROAN Standards. Oil will be drained and inspected for contamination.

o. Fire extinguishes will be removed, weighed and inspected for corrosion and serviceability in accordance with the applicable IROAN Standard.

p. Midship bearings will be inspected for corrosion and serviceability in accordance with the applicable IROAN Standards.

q. All support assemblies will be removed, disassembled, inspected, repaired, or replaced in accordance with the applicable IROAN Standard.

FIGURE 2. Sample Repair Concept (Sheet 1 of 2)



**MIL-STD-91621 (MC)**

r. Generators will be checked during pre-induction testing for voltage output, overheating or unusual noises. If any of these conditions exist the generator will be repaired in accordance with applicable rebuild standard. Starters will be checked for current draw, overheating or unusual noises. If any of these conditions exist the starter will be repaired in accordance with applicable rebuild standard.

s. Replace all fuel and cooling hoses. The exception will be the silicon rubber hoses which will be inspected and replaced as required. Metal lines will be inspected and repaired or replaced as required.

t. Communication equipment and cables will be tested in the vehicle for proper operation. Equipment not forwarded with the vehicle but required to perform operational testing will be temporarily installed for test purposes. If the equipment does not operate properly it will be removed and repaired in accordance with the applicable rebuild standard.

u. Remove the weapon systems if installed and route to proper work center. Inspect/test/repair as required. Reinstall if directed by the repair order.

v. Hydraulic bilge pumps will be removed and tested and have ECP 02161 applied to correct internal relief valve settings if not previously installed. Pressurize hydraulic system to 2300 psi and check for leaks.

w. Electrical bilge pumps will be energized in the vehicle and checked for operational serviceability. Repair/replace unserviceable pumps. Electric wiring and connectors for the pumps will be checked for serviceability and repaired or replaced as necessary.

x. Driver's display module will be tested to determine if the display module requires repair/ replacement or can be reused without disassembly.

y. Propulsion drive shafts will be inspected and checked for worn bearings. If the bearing is worn or shaft does not turn or makes a grinding noise, disassemble and repair in accordance with the applicable IROAN Standard.

z. Contact coolers will be pressurized and tested for leaks. Leaks will be repaired as required.

aa. Shock absorbers will be inspected for leaks and shock bearings for excess wear or cracking. Replace as required in accordance with the applicable standard.

ab. Watertight integrity will be in accordance with DMA Standards.

ac. Cold start system will be modified in accordance with ECP 5094.

ad. Magnetic navigational system, if present, will be removed (ECP 5001).

ae. Vehicles will be prepared for final paint in accordance with approved DMA Standards and as set forth in TM 4750-15/1. Rusted or corroded areas will be cleaned and treated as directed by Quality Control Branch. Sandblasting of hulls may be authorized on a case by case basis by Industrial Engineering Branch. Exterior of vehicles will be painted in accordance with TM 4750-15/1 and 15/2 and current work order. Interior may be touched up in accordance with TM 4750-15/1 and current work order using the color matching as closely as possible the original color.

af. Sandblasted parts and components must be treated or prime painted to prevent corrosion.

ag. Preserve the vehicle as directed.

ah. Appendix B contains additional repair procedures.

**FIGURE 2. Sample Repair Concept (Sheet 2 of 2)**

**MIL-STD-91621 (MC)**

**REPAIR PROCEDURES**

**QUALITY CONTROL**

a. Pre-repair Inspection. Perform a visual inspection and operational test of the vehicle. Use check sheets (Appendix C) to list discrepancies. Furnish copies of check sheets as required by DMA procedures.

**TRACKED ORDNANCE**

b. Disassembly.

- (1) Remove tracks.
- (2) Place the vehicle at the work station and remove the power pack assembly.
- (3) Remove deck plates.

**COMMUNICATIONS**

c. Remove Communication Equipment If Installed.

**NOTE**

**COMMUNICATION WIRING HARNESS WILL REMAIN IN THE VEHICLE AT THIS TIME**

**CLEANING**

d. Cleaning.

(1) Clean the vehicle to remove grease, oil, and dirt. Particular attention should be given to the power pack area and under the deck plates. Thorough cleaning is required so the shop inspectors will be able to detect defects.

(2) Cleaning support: Perform other cleaning operations as required to support the repair of the vehicles.

**NOTE**

**STAGE 3 CORROSION ON HARDWARE WILL NOT BE CAUSE FOR REPLACEMENT UNLESS WRENCH FIT IS LOST ON NUTS AND BOLTS.**

(3) Remove loose scale corrosion and then treat with a phosphoric acid solution. After the solution has dried apply a coat of corrosion prevent compound conforming to MIL-C-85045 (AS).

**TRACKED ORDNANCE**

e. Vehicle Repair.

- (1) Position the vehicle at the work station.
- (2) IROAN the electrical wiring harness.

**NOTE**

**REPAIRS TO WIRING HARNESS WILL BE MADE WITHOUT REMOVAL FROM VEHICLE IF POSSIBLE. WIRING HARNESS, AND MECHANICAL REPAIRS WILL BE PERFORMED SIMULTANEOUSLY.**

(3) IROAN the following components in accordance with applicable IROAN and DMA Standards.

- (a) Hatch and ramp seals.
- (b) Hydraulic systems. Pressurize to 2300 PSI and check for leaks.
- (c) Fuel cell, hull stiffener, ramp, hatch and plenum hinges, locking handles springs, towing pintle and contract cooler.
- (d) Midship bearings, fire extinguishes, air filter locking linkage, universal joints, final drives, track idler and road wheels.
- (e) Support assemblies will be disassembled 100%.
- (f) Weapon system (if installed).
- (g) Check batteries for serviceability.
- (h) Perform other repairs as stated in the Repair Order.

**NOTE**

**COMPONENTS THAT REQUIRE REMOVAL FOR REPAIR OR TESTING WILL BE ROUTED TO APPROPRIATE CWC FOR REPAIR.**

(4) The following repairs/replacements will be made on all vehicles.

**FIGURE 3. Sample Repair Procedures (Sheet 1 of 3)**

**MIL-STD-91621 (MC)**

(a) Replace all hoses with the exception of silicone hoses which shall be replaced as required.

(b) Replace fiber bearing in propulsion unit if required.

(c) Apply applicable modifications and Engineering Change Proposals (ECPs) if kits or part pieces are available.

(5) Component Repair.

(a) Fire Extinguisher.

1 Remove the fire extinguishes from the vehicle.

**NOTE**

**RECOMMENDED WEIGHT FOR EACH CYLINDER IS STAMPED ON THE FLOOD VALVE. ALSO CHECK CYLINDER DATE FOR HYDROSTATIC TEST REQUIREMENTS, SEE MCO 10330.2B.**

2 Place the fire extinguisher cylinder on the scales and check the weight and pressure. If the weight or pressure is less than required, discharge the cylinder and recharge to the proper weight and pressure. If weight and pressure is correct no repair is required. Replace tag and update.

**NOTE**

**FIRE EXTINGUISHER CYLINDERS WILL BE TESTED IN ACCORDANCE WITH MCO 10330.2B AND TM 07007B-50/5.1 OR 5.2. A NEW TAG WILL BE PLACED ON THE EXTINGUISHER AFTER TESTING.**

**ENGINE SECTION**

(6) Engine Repair.

(a) When the engine requires repair to comply with serviceability standards, the applicable IROAN standard will be used and repairs will be as follows:

1 Place the engine on the dynamometer and perform dyno test. Record results of test on dyno test sheet.

2 Repair engine if required.

3 After repair, the engine will be retested to assure performance and reliability.

(b) IROAN fuel injectors and fuel pump.

**TRANSMISSION SECTION**

(7) Transmission Repair.

(a) Place the transmission on the dynamometer and perform test to determine serviceability and repair as required.

(b) Repair the transmission if required.

(c) Remove and replace the main hydraulic pump.

(d) Remove the hydrostatic steer unit, inspect and test 100% in accordance with the applicable IROAN Standard.

(e) IROAN the PTO.

(f) IROAN the final drive.

**ELECTRICAL SHOP**

(8) Electrical Component Repair.

(a) IROAN the generator if not tested on initial STE-ICE test or if the test indicated a problem.

(b) Route the generator to the assembly station after repair.

(c) Check the starter "current draw" in vehicle with STE-ICE equipment. Repair or replace if necessary.

(d) Other electrical components that are found to be inoperable at inspection will be repaired.

**BODY SHOP**

(9) IROAN the radiator in accordance with applicable standard to determine condition. If the radiator is serviceable, return for reuse. If the radiator is unserviceable, notify appropriate work center.

(10) IROAN the contact cooler in accordance with applicable standard.

**TRACKED ORDNANCE**

(11) Assemble and Test Vehicle.

**FIGURE 3. Sample Repair Procedures (Sheet 2 of 3)**

**NOTE**

THE ENGINE AND TRANSMISSION WILL BE PLACED ON A SUITABLE STAND AND UNITE THE TWO COMPONENTS. ASSEMBLE THE COOLING TOWER TO THE POWER PACK. PERFORM OPERATIONAL TEST ON THE POWER PACK ASSEMBLY AND CHECK FOR WATER AND OIL LEAKS AND SERVICEABILITY.

(b) Quality Control Branch performs final inspection as specified in inspection procedures.

- (a) Install the power pack in the vehicle.
- (b) Complete reassembly of the vehicle.
- (c) Notify Quality Control that the vehicle is ready for road and pool test.
- (d) Complete any repairs required. After vehicle has satisfactorily completed all testing, vehicle to receive final cleaning.

**CLEAN/PAINT**

- (12) Final clean and paint.

**NOTE**

VEHICLE WILL BE PAINTED AS DIRECTED ON THE REPAIR ORDER. INTERIOR TOUCHUP IS PREFERRED.

- (a) Hand clean spots when necessary to prepare for paint.
- (b) Prime areas to be painted as required and allow to dry.
- (c) Spot paint as required and allow to dry.

**COMMUNICATION EQUIPMENT REPAIR**

- (13) Communication Equipment Repair.

- (a) Install communication equipment in the vehicle in accordance with shop repair order.
- (b) Perform an operational check.

**QUALITY CONTROL**

- (14) Final Inspection.

- (a) Perform final inspection on vehicle to ascertain all repairs are complete.

FIGURE 3. Sample Repair Procedures (Sheet 3 of 3)

MIL-STD-91621 (MC)

## U.S. MARINE CORPS TECHNICAL MANUAL

---

**INSPECT, REPAIR ONLY AS NECESSARY (IROAN)  
STANDARDS FOR**



THIS PUBLICATION IS REQUIRED FOR OFFICIAL USE OR FOR ADMINISTRATIVE OR OPERATIONAL PURPOSES. DISTRIBUTION IS LIMITED TO U.S. GOVERNMENT AGENCIES ONLY. OTHER REQUESTS FOR THIS DOCUMENT MUST BE REFERRED TO: COMMANDANT OF THE MARINE CORPS (ARE-B), WASHINGTON, D.C. 20380-0001.

**DESTRUCTION NOTICE:** FOR UNCLASSIFIED, LIMITED DOCUMENTS DESTROY BY AN METHOD THAT WILL PREVENT DISCLOSURE OF CONTENTS BY RECONSTRUCTION OF THE DOCUMENTS.

---

**CONTRACT NO.**

**JANUARY 1989**

Figure 4. Sample Title Page.

RECORD OF CHANGES			
Change No.	Date	Title or Brief Description	Entered By

**Figure 5. Sample Record of Changes.**

MIL-STD-91621 (MC)

IROAN STANDARDS

TABLE OF CONTENTS

	PAGE
List of Illustrations . . . . .	V
List of Tables . . . . .	VI
Safety Summary . . . . .	VII
CHAPTER 1	
Section I. Scope, Purpose, and IROAN Requirements . . .	1-1
Section II. Description . . . . .	1-2
Section III. General Criteria . . . . .	1-9
CHAPTER 2	
Section I. General Information . . . . .	2-1
Section II. Overview . . . . .	2-2
Section III. Repair . . . . .	2-5
Section IV. Quality Control . . . . .	2-7
CHAPTER 3	
Section I. Engine Assembly . . . . .	3-1
Section II. Fuel Pump Assembly (P7A1/C7A1) . . . . .	3-11
Section III. Fuel Pump Assembly (R7A1) . . . . .	3-13
Section IV. Fuel Injector Assembly . . . . .	3-15
Section V. Turbocharger Assembly . . . . .	3-19
Section VI. Power Train Installation . . . . .	3-23
CHAPTER 4	
Section I. Transmission Assembly . . . . .	4-1
Section II. Power Take-Off Assembly . . . . .	4-21
Section III. Hydrostatic Steer Unit . . . . .	4-29
CHAPTER 5	
Section I. Hull Bolted Assembly . . . . .	5-1
Section II. Hull Welded and Machined . . . . .	5-3
Section III. Stowage Installation . . . . .	5-5
Section IV. Ramp Lock Installation . . . . .	5-7
Section V. Blackout Cover Installation . . . . .	5-9
Section VI. Equipment Guard Installation . . . . .	5-11
Section VII. Floor Plate Installation . . . . .	5-13
Section VIII. Insulation Installation . . . . .	5-15

Figure 6. Sample Table Of Contents.

SAFETY SUMMARY

**CAUTION**

Dial indicator could be damaged if rocker lever springs back after barring forward. Release rocker lever slowly with actuator when checking indicator reading (p. 3-15).

**WARNING**

Electrical current can burn you. Extreme caution should be taken when making voltage check (p. 13-1, 14-4, 14-7).

**WARNING**

People can be killed or injured if cupola should fall. Keep personnel away from weapon station stand when removing and installing cupola (p. 20-1).

**CAUTION**

Make sure that electrical harnesses and components attached to cupola and basket are detached or removed before lifting cupola (p. 20-3).

**WARNING**

The equilibrator contains highly compressed springs that could injure personnel. Do not disassemble equilibrator without safety screw or pin installed (p.20-17).

**WARNING**

If you assemble the equilibrator in a press, use extreme care. Do not compress springs more than needed. Flying springs and pull rod could kill or injure you (p. 20-17).

**CAUTION**

Ensure winch station hatch is fully open or fully closed (p. 21-7).

Figure 7. Sample Safety Summary.



CHAPTER

Section \_\_. SCOPE, PURPOSE, AND IROAN REQUIREMENTS

-1. **SCOPE.** This manual provides a description of the equipment and contains the Depot Level IROAN requirements necessary to restore the end item to a serviceable condition (condition code "A").

-2. **PURPOSE.** The purpose of this manual is to provide the procedure for restoring the equipment to a serviceable condition in accordance with the Inspect, Repair Only As Necessary (IROAN) maintenance concept.

a. IROAN is defined as *"That maintenance technique which determines the minimum repairs necessary to restore equipment, components, or assemblies to prescribed maintenance serviceability standards by utilizing all available diagnostic equipment and test procedures in order to minimize disassembly and parts replacement."* Serviceability standards shall be met to ensure excellent operating capability.

b. The requirements and procedures contained in these standards provide the information required for testing, inspection of parts, assemblies, and the end item. It also contains final inspection and acceptance testing procedures.

c. Components or assemblies will not be disassembled for replacement of mandatory parts unless that part has failed, or the component assembly wherein the part is located is disassembled for repair.

-3. **IROAN REQUIREMENTS.** IROAN of the equipment will be accomplished through the application of approved maintenance techniques by experienced journeyman-level personnel to meet quality control criteria as follows:

a. Perform the pre-shop induction inspection and testing using the inspection sheets provided in Appendix \_\_ in the following sequence:

- (1) Visual Inspection
- (2) Energize If Possible
- (3) Operational/Road Testing
- (4) Diagnostic (STE/ICE, etc.,)

testing

- (5) Special Performance (Floatation etc...) Testing

When performing these inspections or tests if a vehicle will not start or a defect is revealed that requires immediate repair or replacement of a part to continue testing or prevent injury to personnel or further damage to the vehicle, testing will cease. A decision must be made whether to effect repair/replacement in this area so testing can be continued, or to induct the vehicle into the shop for repair. There are too many variables for a standardized solution. Quality Control Branch in consonance with the Shops, Industrial Engineering and Production Planning Branches will make this decision on the case-by-case basis.

b. When inspection and testing have been completed, the check sheets will be submitted to the Head of the Quality Control Branch for evaluation. Based on this evaluation and working in consonance with Industrial Engineering, Shops, and Production Control Branches, the extent of repair and parts required to meet serviceability standards for the end item can be estimated. Vehicles processed as described above will be condition code "A" when completed.

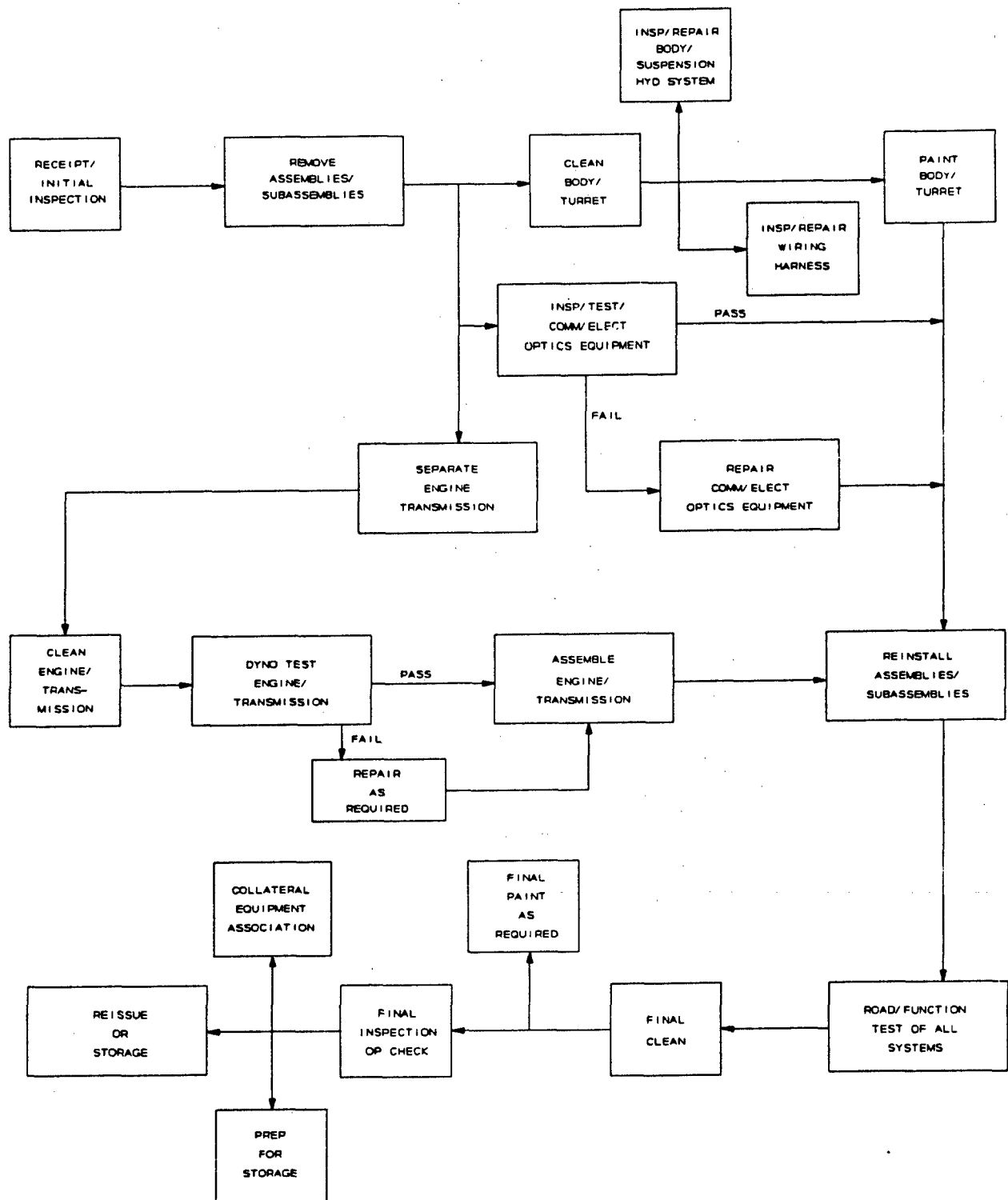


Figure 9. Sample Flow Plan.

# MIL-STD-91621 (MC)

## CHAPTER

### Section 20. EDWS Cupola and Basket Components

#### END ITEM EDWS CUPOLA AND BASKET COMPONENTS

NSN 1005-01-131-8943  
PN 5428039  
DWG 5428039

#### TABLE OF CONTENTS

PARAGRAPH	PAGE
20-1.1 IROAN Description . . . . .	20-1
20-1.2 Special Equipment . . . . .	20-1
20-1.3 Test Procedure . . . . .	20-1
20-1.4 Pass/Fail . . . . .	20-3
20-1.5 Mandatory Replacement Parts . . . . .	20-3
20-1.6 Finishing . . . . .	20-3
TABLE	
20-1 Special Equipment - EDWS Cupola and Basket Components . . . . .	20-2

#### 20-1.1 IROAN DESCRIPTION

**20-1.1.1 Scope.** This standard covers the IROAN requirements for the EDWS, cupola and basket components. This section will also cover the magazine, seat and hatch assembly.

**20-1.1.2 Applicable Standards.** The following sections covering subassemblies of the electric drive weapon station, form parts of this chapter.

- Section II. Elevation Drive Assembly
- Section III. Azimuth Drive Assembly
- Section IV. Gunner's Control Handles
- Section V. Deck Clearance Control
- Section VI. Electrical and Electronic Components
- Section VII. Gun Sights
- Section VIII. Rotor and Components
- Section IX. Control Box and Weapon Feed System

**20-1.1.3 IROAN Phases.** This paragraph divides each IROAN phase into general work and material equipment requirements. The phases are: Special Equipment, Test

Procedures, Pass/Fail, Mandatory Parts, and Finishing. Each phase, if applicable, is explained in detail in subsequent paragraphs.

**20-1.2 SPECIAL EQUIPMENT.** Table 20-1 lists the special equipment required for the electric drive weapon station removal and installation.

**20-1.3 TEST PROCEDURE.** The test procedures for the EDWS cupola and basket components will include the preinduction tests and a thorough visual inspection with limited functional tests and adjustments. All weapon stations will be removed from the vehicles and routed to appropriate work center for complete testing.

#### WARNING

People can be killed or injured if cupola should fall. Keep personnel away from weapon station stand when removing and installing cupola.

Figure 10. Sample Major Assembly Chapter (Sheet 1 of 2).

**CAUTION**

Make sure the electrical harnesses and components attached to cupola and basket are detached or removed before lifting cupola.

Inspect the smoke grenade launcher receptacles for dents, cracks, breaks and corrosion. Check the wiring harness for serviceability. Ensure the guard is not bent or broken. Check all the protective covers for cracks and tears. Check the firing contact (squib) for voltage.

Inspect the cupola hatch seals for serviceability. Check for cracks and dents or broken welds in the hatch. Ensure that all hatch pads are in place and in serviceable condition. Open and close the hatch to ensure that torsion springs are functioning properly.

Inspect the hatch latches for worn or broken parts. Ensure the springs are not weakened or cracked.

Inspect the vision blocks and mounts for cracks, breaks and serviceability.

Inspect the magazine cover latch, bracket, and hook for serviceability. Ensure that the spring is not cracked or broken.

Check the azimuth indicator pointer for bends or cracks.

Remove the azimuth bearing from the cupola. Replace all seals in accordance with TM 08600A-50/8. Inspect all parts; replace all mandatory replacement parts. Reassemble and shim in accordance with TM 8600A-50/8.

Check the CBR hoses, clamps, quick disconnects, and brackets, for serviceability.

Inspect the basket assembly for bent, broken, or missing parts. Check the magazine for serviceability. Inspect the smoke grenade launcher storage box for bent, broken, or missing parts and serviceable tie down straps.

Inspect the seat assembly. Check the seat for cracks, breaks, loose or missing parts. Ensure the cushions and covers are serviceable. Check the pivot latch for serviceability.

Inspect the post, support, and spring for serviceability.

Inspect all threaded parts for burrs and cross threads.

**20-1.4 PASS/FAIL.** After all tests and inspections have been performed, replace or repair all defective parts in accordance with TM 08600A-50.

Disassembly shall not exceed the level required to inspect or repair an item or an assembly.

**20-1.5 MANDATORY REPLACEMENT PARTS.** Mandatory replacement parts will be replaced only when an item or assembly is disassembled for inspection or repair. Refer to TM 08600A-50 for parts listing.

**20-1.6 FINISHING.** Finish in accordance with DMA Standards and TM 08600A-50.

## Special Equipment - Engine Assembly

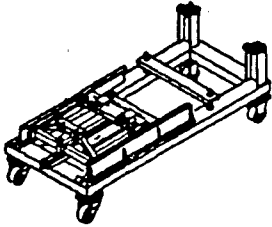
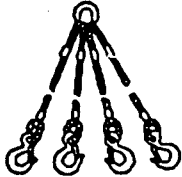


ITEM, PN AND NSN	ITEM NO.	USE
Stand, power pack PN 2590065 or equivalent 	1	Used in disassembly/assembly of power plant.
Sling, multipurpose PN 2586980 or equivalent 	2	Multi-purpose lifting (engine, engine flywheel, etc.)
Gage, belt tension P/N 1138 	3	Check belt tension on water pump V-belt.
Torque wrench, click-type (15 to 100 FT LB) PN ST-1299 or equivalent 	4	Torque oil drain plugs, filter center bolts, crosshead and rocker level locknuts, and rocker housing covers.

Figure 11. Sample Of Special Equipment List.

MIL-STD-91621 (MC)

DYNAMOMETER RUN-IN SCHEDULE  
CUMMINS DIESEL VT-400 (AAV7A1) - DYNAMOMETER TEST LOG  
(TM-88643B-50)

Job Order No: _____		Serial No: _____		Date: _____				
Test Period	Time In Minutes	Engine RPM	Dyno Load (H.P.)	Smoke Density	Oil Press.	Oil Sump Temp.	Water Temp.	Fuel Press.
1	5	800	30					
2	15	1200	75					
After completion of the 2nd period, adjust engine speed with fuel pump governor. w/o load 3190 RPM (maximum)								
3	15	2600	280					
4	5	2800	35					
5	3	FINAL CHECK RUN. Run engine at 2800 RPM; full throttle, full load. Output torque: ft lbs (700 to 825 Corrected)						
6	5	800	20					

After the 6th period, tighten cylinder head bolts/nuts; adjust valves and injector nozzles. Short output test according to period 4.

PT Injector

$0.187 \pm 0.001$  Injector Timing Gap

Normal lube oil pressure: 10 PSI minimum at idle and 30 PSI at 2600 RPM.

Lube oil sump temperature: 285° maximum.

Normal coolant temperature: 175-200°F.

Maximum fuel inlet temperature: 160°. Actual \_\_\_\_\_°.

Maximum exhaust back pressure: 3 in. mercury @ 2800 RPM, full rack, full load.

Actual \_\_\_\_\_.

Maximum crankcase pressure at 2800 RPM, full rack, full load: 13" H<sub>2</sub>O

Actual \_\_\_\_\_.

Smoke Density: 45 or less @ 2000 RPM, full load. Actual \_\_\_\_\_.

Figure 12. Sample Engine Run-In Data Sheet (Sheet 1 of 2).

MIL-STD-91621 (MC)

RUN-IN RECORD

ITEM NO.	TEST RESULT	OPERATOR'S INITIALS
-------------	----------------	------------------------

Diesel Fuel Used  
W-F-800 \_\_\_\_\_

Oil Used  
MIL-L-21260

Fuel Consumption

1. Pounds/observed bhp-hr at 2800 RPM full rack 0.40 lbs/bhp/hr. \_\_\_\_\_
2. If abnormal noise, describe conditions. \_\_\_\_\_
3. Smoothness at idle. \_\_\_\_\_
4. Engine Malfunction. \_\_\_\_\_

5. REMARKS: \_\_\_\_\_

Operator \_\_\_\_\_ Date \_\_\_\_\_ Inspector \_\_\_\_\_ Date \_\_\_\_\_

CORRECTION FACTORS

1. Horsepower Correction Data:
  - a. Barometric pressure in HG: \_\_\_\_\_
  - b. Wet bulb temperature °F: \_\_\_\_\_
  - c. Dry bulb temperature °F: \_\_\_\_\_
  - d. Fuel line restrictor installed (size): \_\_\_\_\_
  - e. Fuel temperature °F at primary filter: \_\_\_\_\_
  - f. Observed HP: \_\_\_\_\_
  - g. Corrected HP: \_\_\_\_\_
  - h. Observed torque: \_\_\_\_\_
  - i. Corrected torque: \_\_\_\_\_

Figure 12. Sample Engine Run-In Data Sheet (Sheet 2 of 2).

MIL-STD-91621 (MC)

Table IROAN Inspection and Acceptance Test - Fire Extinguisher Cylinder (7 lb)

ITEM NO.	INSPECTION FOR	PASS	FAIL
1	Secureness of threaded fasteners to include valve, safety nut, outlet/recoil assembly.		
2	<u>WEIGHT</u> Weigh cylinder assembly. Filled weight must be 7.0 to 7.5 pounds more than empty weight of the cylinder.		
3	<u>PRESSURE</u> Pressure (corrected for temperature per Table 17-6) shall not be more than 10% below the pressure marked on the tag.		
4	<u>FINAL CHECK</u> Protective caps (installed on exposed threads until ready for reuse. Ensure that the following information is recorded on the inspection tag.  a. Empty weight. b. Filled weight. c. Temperature when pressure checked. d. Date testing completed.		

Table Ambient Temperature/Pressure Correlation Table

AMBIENT TEMPERATURE °F (+2 °F)	PRESSURE psig (+2.5%)
120	815
100	718
80	636
70	600
60	565
40	499
20	444
0	397
-20	357
-40	324
-60	295

Figure 13. Sample Test Procedures



.6 FINISHING. Prime and paint the main water jet propulsion unit in accordance with TM 4750-15/1 and appropriate DMA Standard.

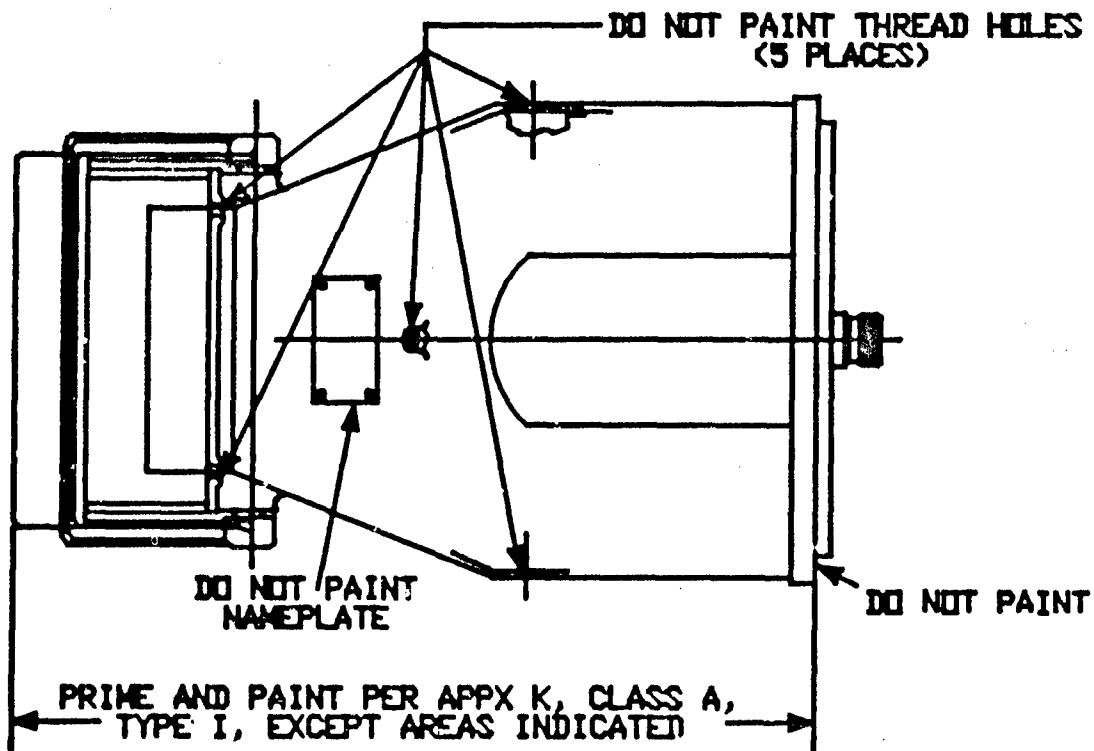


Figure 14. Example Of Detail Finishing Procedures.

MIL-STD-91621 (MC)

Applicability . . . . .	1.2	1
Basic IROAN Document . . . . .	5.2	10
Configuration . . . . .	5.14	13
Corrosion . . . . .	5.11	12
Defects . . . . .	5.10	12
Disassembly . . . . .	5.7	12
Use of Rebuild Standards . . . . .	4.2.1	6
Final Inspection and Acceptance Testing . . . . .	4.2.5	7
Final Acceptance Record . . . . .	5.15	13
General . . . . .	5.1	9
General . . . . .	4.2.7	7
General Inspection Requirement . . . . .	4.2.6	7
General . . . . .	6.1	14
Government Documents . . . . .	2.1	1
Inspection . . . . .	5.5	11
Inspection Forms, Reports and Records . . . . .	4.3.2	8
Inspection Requirements . . . . .	4.3.3	8
Inspection of Parts . . . . .	4.2.3	7
Inspection of Parts . . . . .	5.13	13
Intended Use . . . . .	6.2	14
Instructions for Use of the Illustrated Parts Breakdown . . . . .	4.2.2	6
IROAN Instruction . . . . .	5.3	10
Item Selection for IROAN Program . . . . .	4.1	5
Mandatory Parts Replacement Under the IROAN Concept of Maintenance . . . . .	5.6	12
Operational . . . . .	5.12	13
Order of Precedence . . . . .	2.2	3
Other Government Documents, Drawings and Publications . . . . .	2.1.2	3

MIL-STD-91621 (MC)

Paint Stripping . . . . .	4.2.4	7
Quality Assurance . . . . .	4.3	8
Rebuild Standards . . . . .	4.2	6
Repair/Replacement . . . . .	5.9	12
Responsibility . . . . .	4.3.1	8
Safety . . . . .	5.4	11
Safety Marking . . . . .	5.4.2	11
Safety During Testing . . . . .	5.4.1	11
Scope . . . . .	1.1	1
Serviceability . . . . .	5.8	12
Specifications and Standards . . . . .	2.1.1	1
Subject Term (Key Word) Listing . . . . .	6.5	14
Tailoring . . . . .	1.3	1
Tailoring Guidance . . . . .	6.3	14
Technical Manual Acquisition . . . . .	6.4	14

## INDEX

	<u>FIGURE</u>	<u>PAGE</u>
Sample Engine Run-In Data Sheet (Sheet 1 of 2)	12	33
Sample Engine Run-In Data Sheet (Sheet 2 of 2)	12	34
Example of Basic Introduction Chapter . . . . .	8	28
Example of Detail Finishing Procedures . . . . .	14	36
Sample Major Assembly Chapter (Sheet 1 of 2) .	10	30
Sample Major Assembly Chapter (Sheet 2 of 2) .	10	31
Sample Record of Changes . . . . .	5	25
Sample Repair Concept (Sheet 1 of 2) . . . . .	2	19
Sample Repair Concept (Sheet 2 of 2) . . . . .	2	20
Sample Repair Procedures (Sheet 1 of 3) . . . . .	3	21
Sample Repair Procedures (Sheet 2 of 3) . . . . .	3	22
Sample Repair Procedures (Sheet 3 of 3) . . . . .	3	23
Sample Safety Summary . . . . .	7	27
Sample Checklist (Sheet 1 of 4) . . . . .	1	15
Sample Checklist (Sheet 2 of 4) . . . . .	1	16
Sample Checklist (Sheet 3 of 4) . . . . .	1	17
Sample Checklist (Sheet 4 of 4) . . . . .	1	18
Sample Flow Plan . . . . .	9	29
Sample of Special Equipment List . . . . .	11	32
Sample Title Page . . . . .	4	24
Sample Table of Contents . . . . .	6	26
Sample Test Procedures . . . . .	13	35

MIL-STD-91621 (MC)

CONCLUDING MATERIAL

Custodian:  
Navy - MC

Preparing activity:  
Navy - MC

# STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

## INSTRUCTIONS

1. The preparing activity must complete blocks 1, 2, 3, and 8. In block 1, both the document number and revision letter should be given.
2. The submitter of this form must complete blocks 4, 5, 6, and 7.
3. The preparing activity must provide a reply within 30 days from receipt of the form.

NOTE: This form may not be used to request copies of documents, nor to request waivers, or clarification of requirements on current contracts. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or to amend contractual requirements.

### I RECOMMEND A CHANGE:

1. DOCUMENT NUMBER  
MIL-STD-91621 (MC)

2. DOCUMENT DATE (YYMMDD)  
2 November 1992

### 3. DOCUMENT TITLE

PRINCIPLES OF INSPECTS REPAIR ONLY AS NECESSARY PROCEDURES AND PREPARATION OF IROAN PUBLICATIONS

### 4. NATURE OF CHANGE (Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.)

### 5. REASON FOR RECOMMENDATION

### 6. SUBMITTER

a. NAME (Last, First, Middle Initial)

b. ORGANIZATION

c. ADDRESS (Include Zip Code)

d. TELEPHONE (Include Area Code)  
(1) Commercial  
(2) AUTOVON  
(if applicable)

7. DATE SUBMITTED  
(YYMMDD)

### 8. PREPARING ACTIVITY

a. NAME  
Commander  
Program Support Directorate (PSE-C)  
MarCorSveCom

b. TELEPHONE (Include Area Code)  
(1) Commercial (2) AUTOVON  
(703) 640-4584 278-4584

c. ADDRESS (Include Zip Code)  
2033 Barnett Avenue, Suite 315  
Quantico, VA 22134-5010

IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT:  
Defense Quality and Standardization Office  
5203 Leesburg Pike, Suite 1403, Falls Church, VA 22041-3466  
Telephone (703) 756-2340 AUTOVON 289-2340